

The Effect of State Appropriations on College Graduation Rates of Diverse Students



POLICY REPORT
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EXECUTIVE SUMMARY

This report examines whether levels of state funding for higher education are associated with college graduation rates, particularly among underrepresented racial and ethnic groups. The assessment is based on an analysis of state appropriations and the six-year graduation rates of all students as well as the graduation rates of three subgroups, including Black, Latinx, and White students. Using a 12-year panel dataset of entering freshman cohorts at most public four-year institutions in the nation, the analyses show how graduation rates can be expected to change as a function of varying levels of state appropriations revenue both between and within institutions. Notably, the report did not examine how institutions specifically use appropriations revenue, which may also have a significant impact on student outcomes. Key findings and implications of three analyses are summarized below.

A Positive Effect on Average

The first analysis examined the average effect of appropriations on graduation rates within institutions over the 12-year period. The results indicated that a 10% increase in appropriations would yield a modest percentage point increase in graduation rates: all students (.20 percentage points); Black students (.41 percentage points); Latinx students (.38 percentage points); and White students (.28 percentage points).

Effects Vary Across Institutions

While state appropriation levels have a positive effect on graduation rates on average, the second analysis demonstrated that the effect on graduation rates varies by institution. Specifically, for any particular institution, a 10% increase in appropriations would be associated with a percentage point change in graduation rates of -.30 to .64 for all students, -.55 to .92 for Black students, -.23 to .79 for Latinx students, and -.35 to .84 for White students. An examination of institutional type indicated that the effect of state appropriations does not vary according to whether an institution is classified as a bachelor's institution, master's university, research university, or Hispanic Serving Institution (HSI). However, the effect of appropriations on graduation rates was much larger at HBCUs than at other institutions. A 10% increase in appropriations

was associated with a .83 percentage point increase in graduation rates of Black students at HBCUs relative to other institutions.

Differences in Funding Levels and Graduation Rates

The third analysis estimated the association between appropriations and graduation rates by examining change within and between institutions over time (rather than only within institutions). This analysis provided the expected percentage point difference in graduation rates between institutions if one has 10% greater appropriations: all students (.67 percentage points); Black students (.49 percentage points); Latinx students (.44 percentage points); and White students (.74 percentage points).

IMPLICATIONS AND POLICY OPTIONS

- The findings indicate that states can improve the graduation rates of diverse students by increasing institutional appropriations. Using conservative estimates, this study suggests that a 10% increase in state appropriations nationally would have yielded about 27,200 more bachelor's degrees to Black, Latinx, and White students who entered the public four-year institutions in the study's sample over the twelve-year period, including 18,900 degrees to White students, 4,800 degrees to Black students, and 3,500 degrees to Latinx students.
 - Although appropriations revenue is directly associated with tuition levels, the fundamental role of appropriations in promoting timely degree completion likely stems from the provision of a high-quality learning environment rather than lower tuition. Accordingly, direct appropriations should be conceived as a complimentary rather than substitutive policy lever for addressing college affordability. Need-based grant aid, for instance, is crucial for ensuring that students of modest means are able to afford college tuition, fees, and the associated cost of living. Policymakers must thus consider both affordability and quality dimensions to higher education finance.
 - Particularly in the wake of the COVID-19 pandemic, a central policy challenge is to ensure that any reductions and stratification in state funding for higher education account for the differential ability of institutions to raise tuition revenue to compensate for lost appropriations as well as differences in the resource needs of institutions with students of varying academic backgrounds, social capital, and financial circumstances. Of concern in the current study are institutions that enroll and graduate a relatively large share of students from diverse racial and ethnic backgrounds. Specifically, bachelor's institutions, HBCUs, and HSIs had higher predicted graduation rates for diverse students than did other institutions, ranging from a 5 to 11 percentage point difference.
- Severe funding cuts for such institutions could have a negative impact on a state's progress toward meeting postsecondary attainment goals, particularly attainment equity for diverse populations.
- Policymakers should consider the role of federal funding for colleges and universities. While state governments must balance their budgets, the federal government does not. Constrained state budgets and higher education's ability to generate alternative revenue (mainly from tuition) have caused higher education to be treated as the balance wheel of state budgets. A federal-state partnership could be developed for higher education to provide direct federal funding for institutions and incentivize additional state funding.
 - The provision of robust public funding should be met with an institutional commitment to quality assurance and accountability in demonstrating that taxpayer dollars are being used efficiently, such as ensuring that educational programs, policies, and services are conducive to timely degree completion. Past research has indicated that a comprehensive student support system, for example, can influence the likelihood of persistence and degree completion, including advising, tutoring, career counseling, and mental health services. Moreover, a set of institutional quality indicators by race and ethnicity could help identify access gaps and convey to policymakers any funding needs for improving educational equity.

The Effect of State Appropriations on College Graduation Rates of Diverse Students

Relatively low graduation rates among students of underrepresented racial and ethnic backgrounds have long plagued higher education in the United States (Bowen, Chingos, & McPherson, 2009).

The percentage of students starting at a public four-year institution who ultimately complete a credential within six years is much lower among Black (50%) and Latinx (59%) students than among Asian (80%) and White (73%) students (National Student Clearinghouse, 2020). Consequently, a significant share of underrepresented students may fail to reap the full benefits of a college education, such as higher income, better health, and greater intergenerational mobility (McMahon, 2009; Mayhew et al., 2016; Torche, 2011). Low completion rates can also fail to maximize the myriad social and economic benefits of higher education for local communities, states, and the nation, including greater employment growth (Shapiro, 2006), lower crime rates (Lochner, 2004), higher levels of civic engagement (Verba et al., 1995), public welfare savings (Landon, 2006), and higher tax revenues (Trostel, 2010). The importance of improving college success among underrepresented students has only grown over the past year as the death of George Floyd in Minneapolis heightened national awareness of racial discrimination, and the COVID-19 pandemic disproportionately limited the employment (Klein & Smith, 2021) and college (Jaggars et al., 2021) prospects of Black and Latinx populations. The potential economic and social consequences of failing to raise college completion rates among underrepresented groups may increase if left unchecked, as population projections through 2060 indicate that the White population will shrink by 10%, compared to an increase in the Black and Latinx populations by 41% and 94%, respectively (Johnson, 2020).

As college completion has become more consequential for individual well-being, social development, and economic growth, however, public investments in colleges and universities have declined. In the wake of the 2001 and 2008 recessions, competing budgetary priorities, and limited increases in tax revenue, state and local support of nearly \$9,500 per FTE student in 2000 fell to \$7,700 by 2018 in constant dollars (SHEEO, 2020). Concomitantly, the real cost of higher education – along with costs in other

personal service industries – has risen significantly over the past few decades (Archibald & Feldman, 2018), which has required steep increases in tuition and fees (Mumper & Freeman, 2005) and significant cost-containment measures, such as the replacement of full-time and tenure-track faculty with part-time and non-tenure track faculty (Kezar & Eaton, 2014). The financial milieu in higher education was further stressed by some state performance-based funding models (Dougherty et al., 2016), which were frequently used to incentivize higher graduation rates but had the unintended consequence of penalizing institutions with fewer resources and larger proportions of minority students (Hagood, 2019; Ortagus et al., 2020; see also Horn & Lee, 2019).

The confluence of these trends raises the urgent question of the extent to which reductions in state funding for higher education can be expected to hinder the ability of institutions to improve completion rates, particularly among underrepresented racial and ethnic groups. The current study begins to address this question through an analysis of state appropriations and the six-year graduation rates of all students as well as the graduation rates of three subgroups, including Black, Latinx, and White students. Using a 12-year panel dataset of entering freshman cohorts at public four-year institutions, the analyses show how graduation rates can be expected to change as a function of varying levels of state appropriations revenue both between and within institutions. Moreover, as institutions may differ in how state funding is utilized to improve educational conditions, variance in the effect of state appropriations is also estimated, and interactions with institutional type (e.g., research university, HBCU) are tested.

CONCEPTUAL FRAMEWORK

State appropriations constitute a significant proportion of revenue for public colleges and universities. In 2017-18, state appropriations per FTE student amounted to 17% of total revenue for all public four-year institutions (NCES, 2020), compared to tuition and fees (21%), sales and services of hospitals (15%), government grants and contracts (14%), nonoperating grants (5%), and investments (5%), among other sources. Both price and quality mechanisms may underlie a relationship between state appropriations and degree completion. In the former, researchers have documented a negative relationship between state appropriations and tuition rates (Koshal & Koshal, 2000; Mumper & Freeman, 2005; Webber, 2017; Bound et al., 2019). Using a very conservative approach, Webber (2017) estimated a pass-through rate from cuts in state appropriations to increases in tuition and fee revenue of between 25 and 30 percent, and thus for every \$1,000 per student cut in state appropriations, the average student would pay \$257 more in tuition and fees. Similarly, Bound et al. (2019) concluded that a 10 percent reduction in state appropriations would result in a tuition increase of \$840 at research universities and \$340 at non-research universities. The net price of college enrollment, in turn, has been negatively associated with the persistence of lower-income students who exhibit greater price sensitivity relative to higher-income students (Bowen, Chingos, & McPherson, 2009).

Alternatively, the relationship between state appropriations and graduation rates can be situated within Astin's (1993) input-environment-output (I-E-O) model, wherein colleges use incoming students as inputs in a learning environment to convert students into, ideally, well-educated graduates. According to the I-E-O model, an institution can improve graduation rates by increasing the quality of its inputs (e.g., better students) or the learning environment (e.g., better faculty). State appropriations and tuition in particular are the main sources of educational expenditures (Leslie, Slaughter, Taylor, & Zhang, 2012), and thus changes in state appropriations may be associated with changes in the quality of the learning environment when holding constant tuition revenue, particularly the extent to which an institution possesses the human and physical capital, programs, practices, and policies that are conducive to student learning and timely degree completion (see

Horn & Tandberg, 2018). For instance, a decline in state funding could affect expenditure levels in critical areas, such as instruction (e.g., full-time faculty, number of course offerings), academic support (e.g., academic administration, curricular development), and student services (e.g., admissions, counseling, student activities), which have been positively, though not consistently, associated with student outcomes (Chen, 2012; Pike, Kuh, McCormick, Ethington, & Smart, 2011; Pike & Robbins, 2020; Ryan, 2004; Webber & Ehrenberg, 2010).

Studies on student-faculty ratios, contingent faculty, and course registration policies are illustrative of the potential impact of reduced funding on graduation rates. For example, in their analysis of eight-year completion rates in NLS:72 and NELS:92, Bound et al. (2010) found that increases in the student-faculty ratio explained about 25 percent of the decline in the average completion rate from 51 percent in the NLS:72 cohort to 46 percent in the NELS:92 cohort. Consequential changes in educational quality may also be reflected in the composition of the faculty workforce. The proportion of part-time faculty on campus or exposure to part-time faculty has been negatively associated with student persistence and graduation rates at four-year institutions (Ehrenberg & Zhang, 2005; Eagan & Jaeger, 2008), which may be attributed to relatively lower instructional effectiveness (Umbach, 2007). Finally, in his study of community colleges in California, Bahr et al. (2015) found that registration priority policies were used to manage student demand for coursework that surpassed institutional capacity, which may have limited degree progress for students relegated to course waitlists.

Given the potential effects of resources on student outcomes, several scholars have documented a direct relationship between state appropriations and postsecondary degree completion (Bound et al., 2019; Chakrabarti, Gorton, & Lovenheim, 2020; Heck et al., 2014; Titus, 2009; Trostel, 2012; Zhang, 2009; Zhao, 2018). Titus (2009) examined state-level panel data from 1992 to 2004 that included both private and public four-year institutions. He found that state need-based aid per undergraduate enrollment and state per capita appropriations for higher education institutions were positively associated with bachelor's degrees conferred per enrollment. Specifically, the bachelor's degree production rate increased by 3% for every 10% increase in

appropriations per capita. Trostel (2012) used state panel data from 1985 to 2006 and conducted an instrumental variable analysis of a composite measure of all degrees produced by public postsecondary institutions per the number of high school graduates four years prior. He concluded that the total degree production rate increased by 3.2 percentage points for every \$1,000 of state funding per high school graduate. More recent research suggests that these effects may vary by institutional type. For instance, Zhao (2018) conducted a fixed-effects panel regression to examine the effect of state appropriations at public institutions between 1987 and 2012. While controlling for net tuition and fees, his results indicated that a one SD reduction in state appropriations per FTE student was associated with a decline of .44 bachelor's degrees per 100 FTE students at master's universities, though no effects were reliably detected at doctoral and bachelor's institutions. Conversely, Bound et al.'s (2019) instrumental variable analysis of 1996-2012 panel data indicated that a 10 percent reduction in state appropriations would yield a 3.6 percent decrease in bachelor's degree production at research universities, though no effect was detected among master's universities.

Three studies have focused on cohort completion rates. Zhang (2009) analyzed a longitudinal panel of four-year institutions with cohorts entering between 1991 and 1998. His institutional fixed-effects model indicated that graduation rates would increase by .64 percentage points for every 10% increase in state appropriations per FTE student. Heck et al.'s (2014) multi-level analysis of public four-year institutions between 1997 and 2007 indicated that a one SD increase in state-level appropriations was associated with a .28 SD increase in institutional graduation rates. Finally, using National Student Clearinghouse outcomes panel data between 2014 and 2018, Chakrabarti, Gorton, and Lovenheim's (2020) instrumental variable analysis indicated that a \$1,000 per student increase in state appropriations at four-year institutions is associated with a 1.5 percentage point increase in the probability that a student earns a bachelor's degree by age 25.

A similar area of research has focused on the effects of educational expenditures on student outcomes (Astin, 1993; Crisp et al., 2018; Deming & Walters, 2017; Gansemer-Topf & Schuh, 2006; Garcia, 2012; Hamrick et al., 2004; Pike et al., 2011; Pike & Robbins, 2020; Ryan, 2004; Titus,

2006; Toutkoushian & Smart, 2001; Webber & Ehrenberg, 2010; see also Bound & Turner, 2007). Past studies have differed in their methodologies and operationalization of expenditures but have generally reached similar conclusions about the significance of resources. For example, Pike and Robbins (2020) employed a within-between analysis of panel data from 2002-2006 and found that both instructional and academic support expenditures had positive within-effects on four-year graduation rates, but only instructional expenditures had a positive effect on six-year graduation rates. Using an instrumental variable analysis, Deming and Walters (2017) examined the effect of total institutional expenditures and price changes on completion rates at non-selective public four-year institutions between 1990 and 2013. Whereas tuition levels were unassociated with bachelor's degree completions, they found that an increase of 10 percent in total expenditures was associated with a 4.6 percent increase in bachelor's degrees awarded.

Only two studies, however, examined the effect of resources on the graduation rates of underrepresented student groups (Crisp et al., 2018; Garcia, 2012). Garcia (2012) found that educational expenditures predicted cohort graduation rates of Latinx students at four-year institutions. Crisp, Doran, and Reyes (2018) used Bayesian model averaging with public four-year broad access institutions (those with an admissions rate of at least 80%) and found that a composite finance variable, including revenue and expenditures, was positively associated with the graduation rates of Black and Latinx students. Given their use of a composite finance variable, however, specific inferences about the effect of state appropriations cannot be made.

RELATED RESEARCH ON GRADUATION RATES

Although the principal research questions in this study focus on resources as an independent variable, it's equally important to understand and model the broader set of factors that may influence graduation rates. Although studies differ in their focus on students or institutions, graduation rates are generally postulated to be a function of factors that reflect or influence the degree to which students are committed to the goal of degree completion and fully engaged in the academic and social life of the

institution (Astin, 1993; Berger & Milem, 2000; Kuh, Cruce, Shoup, & Kinzie, 2008). Consistent with student-level analyses of college completion (e.g., Astin & Oseguera, 2012), institution-level analyses have revealed that several structural, contextual, demographic, and affordability variables are predictive of graduation rates at four-year institutions (Gansmer-Topf & Schuh, 2006; Horn & Lee, 2016; Pike 2013; Pike & Robbins, 2020; Ryan, 2004; Scott et al., 2006; Titus, 2004; Toutkoushian, 2019; Webber & Ehrenberg, 2010; Zhang, 2009). A brief overview of findings in each area elaborates the conceptual framework used in this study.

Among the structural variables, private relative to public institutional control, institutional size, admissions selectivity, and the percentage of graduate students on campus have been positively associated with graduation rates (Horn & Lee, 2016; Pike, 2013; Titus, 2004). There is less consensus about whether Black students have a higher likelihood of graduation at a historically-Black college and university (HBCU) than at primarily White institutions (e.g., Kim & Conrad, 2006; Outcalt & Skewes-Cox, 2002). Whereas cross-sectional models have shown that HBCUs have lower expected overall graduation rates (Toutkoushian, 2019), hybrid regression analyses have shown a positive effect (Pike & Robbins, 2020). Analyses of Carnegie classification have shown variation in student engagement by institutional type (McCormick et al., 2009) but have yielded mixed effects on graduation rates, including a positive effect of being a master's university relative to a baccalaureate college (Pike & Robbins, 2020; Toutkoushian, 2019), a negative effect of being a doctoral university (Oseguera, 2005), and no direct effects of any classification type (Horn & Lee, 2016; Pike & Graunke, 2015). Analyses of institutional type appear to be highly sensitive to the composition of the institutional sample, type of graduation rate (four-/six-year), model specification, and reference category.

The urbanization status and region of the institution have been commonly examined as contextual attributes (Horn & Lee, 2016; Toutkoushian, 2019). Specifically, institutions located in an urban area relative to a rural or suburban area have lower expected graduation rates (Horn & Lee, 2016). Institutions located in the New England and Mid-Eastern regions relative to the Plains region have higher expected graduation rates (Toutkoushian, 2019).

In the demographic category, several characteristics of first-time students are of interest, including academic preparedness, gender, race and ethnicity, family income, and traditionality. The average academic preparedness of students measured by ACT/SAT scores and the percentage of female students in the beginning cohort have predicted higher graduation rates (Horn & Lee, 2016). Other factors such as the percentage of students from underrepresented racial and ethnic groups, the percentage of Pell grant recipients, the percentage of older adults on campus, and the percentage of part-time students on campus have been associated with lower graduation rates (Toutkoushian, 2019; Webber & Ehrenberg 2010). Moreover, delayed enrollment – postponing postsecondary enrollment after graduating from high school – has been negatively correlated with the odds of obtaining a bachelor's degree at the individual level (Bozick & DeLuca, 2005); however, Pike and Robbins (2020) did not detect a robust effect at the institutional level.

Finally, in the affordability rubric, researchers have examined the effects of tuition and various types of financial aid. Since more selective institutions generally have both higher tuition and graduation rates, regression models have yielded a positive effect of tuition and fees on graduation rates (Zhang, 2009), though net price – tuition after subtracting financial aid – has been negatively associated with graduation rates (Bowen, Chingos, & McPherson, 2009). Whereas past studies on the effect of loan aid have yielded mixed results (Hillman, 2015), past research has demonstrated a positive effect of federal Pell aid on persistence (Bettinger, 2004), state need-based aid on persistence and degree completion (Castleman & Long, 2013; Chen & St. John, 2011; Titus, 2006; cf. Anderson et al., 2020), and institutional grant aid on degree completion (DesJardins & McCall 2010; Pike & Robbins, 2020). For example, Castleman and Long's (2013) student-level analysis showed that receipt of the Florida Student Assistance Grant was associated with a five percentage-point increase in the likelihood of attaining a bachelor's degree within six years. However, Pike's (2019) institution-level analysis indicated that only the average institutional grant aid amount – not loan aid or federal or state grant aid – was associated with six-year graduation rates. Analyses conducted at the institutional level may thus fail to replicate findings at the student level.

THE CURRENT STUDY

While several studies have documented a positive effect of public funding on degree production and cohort graduation rates, the scope, magnitude, and variation of any consequences for the graduation rates of underrepresented student groups are less understood. Two research objectives guide the analysis. First, the current study estimates the effect of appropriations on the cohort graduation rates of all students as well as the subgroup graduation rates of Black, Latinx, and White students. Past investigations have mainly focused on the potential effect of state appropriations on overall degree production or graduation rates (e.g., Zhang, 2009), which limits confidence in the generalizability of effects to underrepresented student subgroups. Institutions may differ in how changes in state funding affect institutional operations, some of which may differentially benefit White and underrepresented students. Moreover, past studies that examined the relationship between resources and the graduation rates of diverse students did not decompose within- and between-institution effects (e.g., Crisp et al., 2018), which can limit inferences about causality. Accordingly, the current study utilizes both standard and within-between mixed regression models with a 12-year institution-level panel dataset to estimate the total, within-, and between-institution effects of appropriations. In line with the conceptual framework, the effect of state appropriations is examined while controlling for potentially confounding influences, including structural, contextual, demographic, and affordability variables. Although not widely used in past research (cf. Taylor & Cantwell, 2019), the analysis also controls for state appropriations as a proportion of educational expenditures since institutions differ in the extent to which public funding is used to supplant other sources of revenue (see Bound et al., 2019).

Second, this study examines whether there is appreciable variance in the regression coefficient for appropriations at the institutional level. Past research has indicated that four-year institutions vary in their efficiency (Horn, Lee, Jang, & Lee, 2019; Toutkoushian, 1999) and effectiveness (e.g., Horn & Lee, 2016) in promoting degree completion. Mixed regression modeling is thus employed to evaluate the fit of a random slope for appropriations, which provides the basis for identifying and studying institutions that may have particularly effective campus practices and efficient

cost structures. As an initial step, an interaction test is conducted to assess the potential role of institutional type in moderating the effect of appropriations on graduation rates. This test is particularly relevant as Black and Latinx students comprise a smaller share of the enrollment at research universities than at baccalaureate and master's institutions, and they constitute a larger share at HBCUs and HSIs, respectively (e.g., NCES, 2019). Past research has yielded mixed results about the potential moderating role of institutional type (Bound et al., 2019; Zhao, 2018).

METHODOLOGY

Data Source

A 12-year panel dataset was constructed with IPEDS for all colleges and universities in the nation with the following characteristics: (a) Title IV participating and degree-granting; (b) public four-year; (c) full-time, first-time undergraduate students are present with an entering cohort of at least 45 students in the first and last years of the panel period (for racial subgroup models, the sample was further restricted to institutions with cohorts of 45 or more in the corresponding racial group); (d) Basic Carnegie Classification: research university, master's university, and baccalaureate college; (e) does not have a military or maritime specialization; (f) is not a parent in a parent-child relationship; and (g) received appropriations from state sources during the panel period. These restrictions yielded an initial sample of 436 four-year institutions.

Variables

Data were obtained for graduation rates by race and ethnicity, structural characteristics, contextual attributes, student demographic characteristics, affordability, and resource variables. The data years for six-year graduation rates spanned from 2007 to 2018. Accordingly, the data years for the predictor variables reflect entering freshman cohorts between 2001 and 2012. Table 1 provides descriptive statistics for the first and last data years.

Graduation rates by race and ethnicity. Six-year graduation rates were obtained for 12 freshman cohorts entering between 2001 and 2012. Graduation rates represent the proportion of full-time, first-time, bachelor's degree-seeking students who completed their program within six years, minus exclusions (e.g., death, military service,

Peace Corps service). Graduation rates were calculated for Black, Latinx, White, and all students (i.e., American Indian or Alaska Native, Asian, Black, Latinx, Native Hawaiian or Pacific Islander, White, and two or more races). Due to small cohort sizes, the graduation rates of American Indian students were not examined separately.

Structural characteristics. Structural characteristics include Carnegie classification, minority-serving status, institutional size, graduate student presence, and admissions selectivity. Carnegie classification was dummy-coded as research (high or very high), baccalaureate, or master's and doctoral non-research (the reference category). Minority-serving status was represented by dichotomous variables for Historically Black Colleges and Universities (HBCUs) and Hispanic-Serving Institutions (HSIs). The HSI variable was based on an undergraduate Latinx student cohort of at least 25 percent. Institutional size was indexed by full-time equivalent undergraduate student enrollment. Graduate student presence is defined as the proportion of graduate students on campus. Admissions selectivity was gauged by the proportion of applicants who were not admitted.¹

Contextual characteristics. Contextual characteristics included variables for urbanization and region. Urbanization was identified by using the Degree of Urbanization variable in IPEDS, which assigns 1 of 12 possible values: large city; midsize city; small city; large suburb; midsize suburb; small suburb; fringe town; distant town; remote town; fringe rural; distant rural; and remote rural. Based on a preliminary analysis, the urbanization variable was dummy-coded with large city as the reference category relative to (a) midsize and small city; (b) any size suburb; and (c) any size town or rural. Eight regions were defined by the Bureau of Economic Analysis, including Far West (AK, CA, HI, NV, OR, WA), Great Lakes (IL, IN, MI, OH, WI), Mideast (DE, MD, NJ, NY, PA), New England (CT, ME, MA, NH, RI, VT), Plains (IA, KS, MN, MO, NE, ND, SD), Southeast (AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV), Rocky Mountains (CO, ID, MT, UT, WY), and Southwest (AZ, NM, OK, TX). The region variable was dummy-coded with Southeast as the reference category.

Demographic characteristics. Relevant attributes of the undergraduate student body include gender, race/ethnicity, socioeconomic status, non-traditionality, and academic preparedness. Gender and race/ethnicity data pertained directly to the degree/certificate-seeking cohorts, which yielded the proportion of female students by race/ethnicity and the proportion of underrepresented students (Black, Latinx, and American Indian). The proportion of full-time, first-time, degree-seeking undergraduate students receiving federal grant aid served as a proxy for the socioeconomic status of students. The presence of non-traditional students was defined by several variables, including (a) the proportion of undergraduate students enrolled part time, (b) the proportion of undergraduate students aged 25 and older, and (c) the proportion of the first-time cohort comprised of students who graduated from high school within the previous 12 months. The institution's 25th percentile SAT test score (math plus verbal) for first-time, degree/certificate-seeking undergraduate students served as a proxy for the average academic preparedness of students. ACT scores were converted to SAT scores for institutions that have a relatively low proportion of students who submit SAT scores (e.g., ACT, 2012).

Affordability. Affordability variables gauged the institution's published in-state tuition and fees as well as various types of financial aid, including the average student loan debt, average federal grant amount, average state grant amount, and average institutional grant amount. All variables were adjusted for inflation using the Consumer Price Index to reflect 2018 dollars.

Resources. Variables reflecting institutional resources included state appropriations and relative reliance on tuition and public funding. State appropriations were calculated per full-time equivalent undergraduate student and adjusted for inflation. Institutional reliance on tuition was defined by tuition revenue as a percentage of total educational expenditures, and appropriations was defined by appropriations revenue as a percentage of total educational expenditures (expenditures on instruction, student services, and academic support). Both variables

¹ Some researchers have also used the admissions yield rate as a predictor, though preliminary analyses indicated it did not improve model fit.

represent the mean value from the first four years of each entering cohort.

DATA ANALYSIS

Linear mixed regression analysis – also termed random effects or multilevel analysis – was conducted with SPSS 27, which accounts for non-independence of errors that may result from the clustered nature of the sample (e.g., institutions within states) and a longitudinal panel design as well as permitting both fixed and random slope models (see Muthén & Satorra, 1995). The treatment of institutions as clustered within states follows from the role of state governments in influencing pre-college academic preparation, financial aid distribution, and institutional revenue (McGuinness, 2011). Moreover, the intraclass correlation, that is, the ratio of between-state variance to total variance in graduation rates indicated that state-level clustering should be addressed: all students ($\rho = .25$); Black students ($\rho = .17$); Latinx students ($\rho = .09$); and White students ($\rho = .20$). Mixed regression analysis models non-independence with higher-level residual terms and separate intercepts for higher-level entities, compared to fixed effects regression which controls higher-level variance through a comprehensive set of dummy variables representing the higher-level entities (thereby eliminating between-effects altogether).

Although the standard linear mixed model can be used to estimate the effects of state appropriations, institutional type, and potential interactions, it may yield biased estimates of the causal effect of state appropriations (and other variables) on graduation rates relative to estimates derived from a fixed effects model. A fixed effects model, conversely, eliminates heterogeneity bias but does not allow modeling of time-invariant factors, such as institutional type. The current study thus employs so-called within-between models to analyze time-invariant factors while decomposing within- and between-cluster effects to minimize confounding influences of unobserved time-invariant variables (see Allison, 2009; Bell & Jones, 2015; Bell, Fairbrother, & Jones, 2019). The within-between model can be conceived as a special type of random effects model (see Bell & Jones, 2015, p. 143) that produces within-effect estimates for time-variant variables that are essentially equivalent to those of a standard fixed effects model. The within-institution

effects of state appropriations, for instance, indicate the extent to which within-institution change in state appropriations is associated with within-institution change in graduation rates. The within-institution effect of state appropriations is also hypothesized to vary significantly across institutions, and thus both fixed and random slope models are tested. Accordingly, two within-between mixed models (a, b) include time-invariant structural attributes (e.g., institutional type), institutional means, and deviations from institutional means. In addition, a standard mixed model (c) was specified to provide an efficient estimation of the total association between state appropriations and graduation rates.

$$(a) y_{itk} = \beta_0 + \beta_1 W(x_{it} - \bar{x}_i) + \beta_2 B \bar{x}_i + \gamma z_i + u_{0k} + \epsilon_{itk}$$

$$(b) y_{itk} = \beta_0 + \beta_1 W(x_{it} - \bar{x}_i) + \beta_2 B \bar{x}_i + \gamma z_i + u_{0i} + u_{1i}(x_{it} - \bar{x}_i) + u_{0k} + \epsilon_{itk}$$

$$(c) y_{itk} = \beta_0 + \beta_1(x_{it}) + \gamma z_i + u_{0k} + \epsilon_{itk}$$

We have institutions $i = 1, \dots, n$ (level 2) that are measured at times $t = 1, \dots, T$ (level 1) and nested within states $k = 1, \dots, K$ (level 3). Here y_{itk} is the dependent variable, x_{it} is a time-varying (level 1) independent variable, and z_i is a time-invariant (level 2) independent variable. The variable x_{it} is divided into two, with each part having a separate effect. Thus, $\beta_1 W$ represents the average within effect of x_{it} , while $\beta_2 B$ represents the average between effect of x_{it} . The γ parameter represents the between effect of the time-invariant variable z_i . The random part of the models includes terms at level 2: a random effect (u_{0i}) attached to the institution-level intercept and a random effect (u_{1i}) attached to the within slope for state appropriations and a term at level 3: a random effect (u_{0k}) attached to the state-level intercept. Finally, all models include a random error term ϵ_{itk} .

Based on analysis of covariance structures, a first-order autoregressive structure with homogenous variances was used for repeated measures. The variable representing the panel year, *time*, was modeled as a fixed slope using dummy variables. Preliminary analyses showed that AIC values were relatively high in the Black and Latinx cohort models unless samples were restricted to institutions with a 2012 cohort of at least 45 students of the race/ethnicity in question. This 45-student minimum was also applied to the White student cohort model for consistency.

The models were developed by entering all variables simultaneously in two steps (a) specification of fixed slopes and a random state-level intercept and (b) specification of fixed slopes, a random state-level intercept, and a random institution-level intercept and slope for state appropriations. The Akaike Information Criterion (AIC) was used to assess improvements in model fit. A proxy for *r*-squared was computed by running the analysis with ordinary least squared regression. A sensitivity analysis was conducted with a single-level fixed effects regression model using clustered state standard errors and time dummies. These models yielded larger effect estimates for state appropriations with higher levels of statistical significance.

Transformations and Missing Data

Several continuous variables were transformed to reduce the influence of outliers. A logarithmic transformation was used to correct positive skewness for several variables. The reflect and log transformation was applied to correct negative skewness for the percentage of students enrolling within 12 months of high school graduation. Extreme multivariate outliers identified through standardized residuals, Cook's D, and Mahalanobis distance were deleted to ensure more stable solutions.

The problem of missing data was most significant for admissions selectivity (11%), the percent of students aged 25 and older (7%), the percent of students with timely entry (8%), and the 25th percentile SAT scores (14%). Institutions with missing data tended to have lower graduation rates, higher percentages of underrepresented and non-traditional students, lower levels of average grant aid, and greater reliance on state appropriations combined with lower levels of appropriations per FTE student ($p < .05$). Missing data are not treated here as if they were missing at random since the reason for missingness was unknown (e.g., lack of institutional reporting capacity, open access), and thus analyses were conducted with listwise deletion, which yielded final sample sizes of 249 to 387 institutions and 2189 to 4055 cases.

RESULTS

Within-Between Direct Effects

The first analysis seeks to determine whether there

is evidence of an effect of state appropriations on graduation rates within institutions. As seen in Table 2, the combination of structural, contextual, demographic, affordability, and resource variables enhanced model fit relative to an intercepts-only model (AIC Difference = 3554.69 to 7892.44). An initial examination of the control variables shows some apparent similarities and differences in effect estimates across racial and ethnic groups. Among the structural variables, bachelor's institutions generally had higher expected graduation rates relative to master's universities. Institutions that were designated as HBCUs had higher graduation rates for all students and Black students, whereas institutions designated as HSIs had higher graduation rates in all models. For example, the graduation rates of Black students are predicted to be 11 percentage points higher at HBCUs than at other institutions, while holding other variables constant.

Among the contextual attributes, some patterns emerged for institutional urbanicity and region. Relative to institutions in large cities, those located in suburbs, towns or rural areas, and "other cities" had consistently higher graduation rates across groups. Regarding geographical region, institutions that were located in the Plains and Great Lakes regions had lower expected graduation rates for Black students, relative to institutions in the Southeast. For instance, the expected graduation rate of Black students was 10 percentage points lower at institutions in the Great Lakes region than at institutions in the Southeast region, while holding other variables constant. Institutions in the Great Lakes region also had lower expected graduation rates for Latinx students.

In the student demographics category, many of the between- and within-effects identified through an analysis of all students generally held across racial subgroups. While focusing on the within-effects, the percentage of female students within each freshman cohort and the SAT 25th percentile score were consistently positively associated with graduation rates. Conversely, the percentage of underrepresented students, the percentage of students over the age of 25, and students who delayed enrollment were negatively associated with graduation rates across subgroups. The effect of family income differed by racial group. The percentage of Pell grant recipients was negatively associated with graduation rates only in the all-students and Black students models.

Regarding affordability within-institution effects, tuition rates were positively associated with graduation rates only in the all-students model. Average state and federal grant aid were generally unassociated with graduation rates with the exception of a negative association between federal grant aid and Black student graduation rates. Average institutional grant aid, however, was positively associated with the graduation rates of all students and White students, while these effect estimates were not significant in the Black and Latinx models.

Among the control variables in the resources category, it is noteworthy that state appropriations as a percentage of educational expenditures was negatively associated with graduation rates. Additional analyses indicated that the inclusion of this control variable increased the magnitude of the regression coefficient for state appropriations per FTE student, thereby indicating that this variable largely functions as a suppressor. Indeed, whereas the bivariate correlation between state appropriations as a percentage of educational expenditures and graduation rates is weakly negative ($r = -.13, p < .001$), it is strongly positively associated with state appropriations per FTE student ($r = .73, p < .001$).

Finally, the within-effects show positive associations between appropriations and graduation rates, and the effects were comparable across subgroups: all students of any race ($b = 2.14$), Black students ($b = 4.33$), Latinx students ($b = 4.12$), and White students ($b = 2.99$). The effect sizes can be conceptualized in terms of the expected percentage point increase in graduation rates within institutions if appropriations were to increase by 10%: all students (.20 percentage points); Black students (.41 percentage points); Latinx students (.38 percentage points); and White students (.28 percentage points).

Variance in the Within-Effect of State Appropriations

While state appropriation levels have a positive effect on graduation rates on average, it is also possible that the effect varies by institution. The second analysis thus builds upon the within-between model by adding a random intercept and slope for appropriations. As depicted in Table 3, model fit was enhanced by adding the random intercept and slopes (AIC difference = 73.89 to 573.75). Overall, the analysis demonstrates substantial variance

in the coefficient for appropriations per FTE across institutions. Covariance estimates for the appropriations per FTE slope differed across models, ranging from 23.85 for all students to 59.41 for Black students. The fixed slope estimate, however, did not retain statistical significance in the Black student model ($p = .23$). Accordingly, using a conservative interpretation, the Black student model indicates that the appropriations slope can be expected to deviate significantly from a point estimate of zero. In order to maintain consistency and avoid underestimating the upper bound of the effect of state appropriations for underrepresented groups, however, the slope coefficients in Table 3 are used to interpret all effects. Specifically, the magnitude of variability can be expressed in 68% confidence intervals for the estimates of the state appropriations slope coefficient: all students ($b = -3.10$ to 6.66), Black students ($b = -5.76$ to 9.66), Latinx students ($b = -2.37$ to 8.33), and White students ($b = -3.68$ to 8.80). Stated differently, for any particular institution, a 10% increase in appropriations would be associated with a percentage point change in graduation rates of -.30 to .64 for all students, -.55 to .92 for Black students, -.23 to .79 for Latinx students, and -.35 to .84 for White students.

Institutional type is one possible source of variation in the effect of state appropriations. Accordingly, interaction terms using institutional type variables – bachelor’s institution, research university, HBCU, and HSI – were added to each within-between model. However, the addition of interaction terms to the random slope model only improved the predictive power of the Black cohort model, namely the HBCU interaction term, AIC difference = 6.30. Specifically, the within-effect of state appropriations per FTE on black cohort graduation rates ($b = 1.10, p > .10$) was larger at HBCUs than at other institutions ($b = 8.72, p < .01$). Accordingly, a 10% increase in appropriations was associated with a .83 percentage point increase in graduation rates of Black students at HBCUs relative to other institutions.

Standard Mixed Model

The previous analyses suggest that state appropriation levels are associated with graduation rates within and between institutions when controlling for other factors. However, the analyses did not efficiently estimate the total association (i.e., within and between) between state appropriations and graduation rates. As indicated in Table

4, the combination of structural, contextual, demographic, affordability, and resource variables enhanced model fit relative to an intercepts-only model (AIC Difference = 3403.21 to 7371.94). The association between appropriations per FTE student and graduation rates was significant for all students of any race ($b = 6.98$), and it was comparable across Black students ($b = 5.19$) and Latinx students ($b = 4.64$). The absolute effect of appropriations appeared to be largest in the model for White students, $b = 7.77$. Indeed, an analysis of effect contrasts indicated that differences were statistically significant between the White and Black cohort models ($b = 2.58, z = 1.67, p < .05$) and White and Latinx models ($b = 3.13, z = 20.1, p < .05$). The effect sizes can be conceptualized in terms of the expected percentage point difference in graduation rates between institutions if one has 10% greater appropriations: all students (.67 percentage points); Black students (.49 percentage points); Latinx students (.44 percentage points); and White students (.74 percentage points). Caution should be exercised when interpreting these associations, as standard mixed models are more susceptible to producing biased estimates for causal inference.

DISCUSSION

Research on student outcomes in higher education has demonstrated that institutional resource levels can influence the cohort graduation rates of diverse students (Crisp et al., 2018). The purpose of the current study was to estimate the specific effect of state appropriations revenue on the six-year graduation rates of all students as well as Black, Latinx, and White student subgroups at public four-year institutions. This study extended past research by employing a within-between mixed regression model with 12-year panel data that accounted for institution- and state-level covariance. The potential for confounding influences was also reduced by modeling the relative effects of structural, contextual, demographic, and affordability variables. Overall, the results indicate that institutional appropriations can be an effective policy instrument for improving the graduation rates of students from underrepresented racial groups as well as White students. Further consideration of these findings underscores important policy implications and directions for future research.

Although the central aim of this study was to examine the

role of appropriations in graduation rates over time, it is noteworthy that similar within-effects of several variables emerged across regression models for Black, Latinx, and White students. Consistent with past research (e.g., Horn & Lee, 2016; Titus, 2004; Toutkoushian, 2019), whereas indicators of the percentage of female students and average academic preparation were positively associated with graduation rates, the percentage of adults over the age of 25 and the percentage of underrepresented students were generally negatively associated with graduation rates. Dissimilar to a past hybrid analysis (Pike & Robbins, 2020), the proportion of students who had delayed enrollment after graduating from high school was negatively associated with six-year graduation rates, which is consistent with Bozick and DeLuca's (2005) individual-level analysis. Finally, institutions designated as bachelor's institutions relative to master's universities and HSIs relative to non-HSIs generally had higher graduation rates. Notably, McCormick et al.'s (2009) indicator of baccalaureate colleges predicted higher levels of student-faculty interaction and enriching educational experiences, whereas their indicators of master's and doctoral institutions predicted a lower perceived campus support among NSSE respondents.

In contrast, the models in this study revealed differential effects of HBCU status, family income, and average financial aid. For example, this study confirmed Pike and Robbins's (2020) finding that HBCUs had higher expected overall graduation rates while holding constant other variables. Moreover, HBCUs yielded a very large positive effect on the graduation rates of Black students in particular. The expected completion rate for Black student cohorts at HBCUs was 11 percentage points higher than at other institutions. This is consistent with Outcalt and Skewes-Cox's (2002) findings that Black students at HBCUs have higher levels of satisfaction on a number of survey items related to diversity and social engagement, such as a sense of community on campus and interactions with other students. Social engagement and sense of belonging, in turn, have been identified as key predictors of student persistence (Tinto, 2012).

The statistical effects of different forms of financial aid also varied across racial and ethnic groups. Whereas past research using student-level data has generally corroborated a positive effect of state, federal, and institutional grant aid (e.g., Hossler et al., 2009), the current

analysis of institution-level data only revealed a positive effect of institutional grant aid. This pattern is consistent with the results of Pike and Robbins's (2020) within-effects regression analysis of total first-time cohorts, though the current study suggests that the effect of institutional grant aid cannot be reliably generalized to Black and Latinx student cohorts. However, a null effect of grant aid using average institution-level data should not be construed as the absence of an effect for underrepresented students on average. Indeed, caution should be exercised when interpreting the results of financial aid variables that represent average financial aid amounts that are not specific to the racial/ethnic cohort in question or the degree to which aid is targeted by financial need or merit.

While controlling for institutional attributes, the analyses of all students and particular racial and ethnic cohorts revealed a positive effect of state appropriations on six-year graduation rates. The standard mixed model results indicated that better-funded institutions frequently have higher graduation rates, wherein a 10% greater amount of appropriations was associated with a .67 percentage point advantage in graduation rates for all students and a .44 to .74 percentage point advantage for the racial subgroups. More conservative estimates were provided in the within-between model, which permits greater confidence in causal inference. Specifically, the within-effects suggest that a 10% increase in state appropriations would be associated with a .20 percentage point increase in graduation rates for all students and a .28 to .41 percentage point increase for specific racial groups. These findings are generally consistent with past research on the effect of public funding on degree production rates (Bound et al., 2019; Titus, 2009; Trostel, 2012; Zhao, 2018), cohort graduation rates (Heck et al., 2014; Zhang, 2009), and the likelihood of bachelor's degree completion (Chakrabarti, Gorton, & Lovenheim, 2020) as well as the relationship between expenditures and graduation rates (Pike & Robbins, 2020) and the effect of total finances on diverse cohort graduation rates (Crisp et al., 2018). However, whereas Zhang (2009) estimated a .64 percentage point increase for a 10% increase in state funding using a fixed-effects model, the current study provides a more conservative estimate of a .20 to .42 percentage point increase. This difference may be attributed to distinct sources of measurement error, types of control variables, institutional samples, or time periods under analysis.

As the current study controlled for tuition and financial aid, the effect of state appropriations is most likely a function of investments in educational quality rather than differences in net price (see Deming & Walters, 2017). Given a direct linkage with educational expenditures (Leslie et al., 2012), an increase in state appropriations revenue may enable improvements in educative conditions conducive to student engagement and timely degree completion, such as promoting instructional excellence, expanding highly effective programs (e.g., service-learning), and strengthening academic and social support (Kuh et al., 2011). Conversely, in the absence of adequate revenue, institutions may inadvertently create structural constraints to student progress by limiting the number and availability of courses (Bahr et al., 2015), allowing student-faculty ratios to become too high (Bound et al., 2010), and relying heavily on part-time and contingent faculty (Eagan & Jaeger, 2008). Future research might profitably model such quality factors that presumably mediate the relationship between appropriations and graduation rates.

Although there was a small positive effect of appropriations on average, the random slope model revealed substantial variation across institutions. Specifically, a 10% increase in appropriations at any particular institution was associated with both negative and positive percentage point changes in graduation rates ranging from -.55 to .84. This is consistent with past research showing that postsecondary institutions differ in their degree of efficiency (Horn, Lee, Jang, & Lee, 2019), the extent to which they are effective in promoting timely graduation after accounting for differences in the quality of inputs and educational expenditures (Horn & Lee, 2016), and the differential ability to protect total educational revenue by raising tuition (Bound et al., 2019). The source of variation in the effect of state appropriations was not readily identified in the moderation analysis of most institutional types. Dissimilar to past research that treated institutional type as a subgroup (Bound et al., 2019; Zhao, 2018), a direct interaction test indicated that the effect of state appropriations did not differ significantly across baccalaureate colleges, master's universities, and research universities.

Designation as a minority-serving institution, however, yielded inconsistent results. Whereas the effect of appropriations did not vary significantly by HSI designation

for the graduation rates of any group, the effect of appropriations on the graduation rate of Black students was about eight times greater at HBCUs than at other institutions. This moderation effect might be attributed to a combination of such factors as resource levels, educational quality, and the average academic preparation of Black students. Many HBCUs operate as open access institutions with modest educational expenditures and a student body that has greater financial and academic challenges. HBCUs may thus benefit greatly from a significant influx of resources, which follows Taylor and Cantwell's (2019) contention that subsidy-reliant institutions would be most efficient in using state appropriations to increase completion rates. Additional research is needed to better understand the potential presence (or absence) of variation in the effect of state appropriations across racial groups as well as factors that may moderate the magnitude of the effect.

Several limitations are suggestive of future directions for research. First, the results cannot be necessarily generalized to institutions beyond the sample, including special focus institutions, broad access four-year institutions that do not require the SAT/ACT for admission, and community colleges. Presumably, the effect of potential changes in state appropriations would be larger for institutions with a more limited ability to compensate for lost public revenue. Second, many institutions experienced relative stagnation in state appropriations during several years of the selected period, which might have led to an underestimation of within-effects. The inclusion of earlier or later data years with greater requisite variance may improve effect estimation. Third, while the study provides estimates of the expected effect of an increase in appropriations on graduation rates, it did not provide a full accounting of costs and benefits to assess the return on a similar investment of taxpayer dollars elsewhere. A cost-effectiveness analysis would also be useful in identifying various types of institutional interventions that are likely to yield the highest return on state appropriations. Fourth, the present study controlled for state cluster effects but did not model state-level variables. Future research might consider the role of such factors as unemployment rates, knowledge workforce indicators, and state governance structures (e.g., Tandberg, 2013; Toutkoushian & Hollis, 1998).

IMPLICATIONS

The findings indicate that states can improve the graduation rates of diverse students by increasing institutional appropriations. Moreover, past reductions in appropriations have likely thwarted progress towards state college attainment goals by limiting institutional effectiveness. Using the conservative estimates from the within-effects model, this study suggests that a 10% increase in state appropriations nationally would have yielded about 27,200 more bachelor's degrees to Black, Latinx, and White students who entered the public four-year institutions in the study's sample over the twelve-year period, including 18,900 degrees to White students, 4,800 degrees to Black students, and 3,500 degrees to Latinx students. In addition, a simulation using the interaction effects with institution type showed that a 10% increase in state appropriations would have yielded about 1,400 more bachelor's degrees to Black students at HBCUs alone. This increased degree production would have presumably led to greater diffusion of the private and public benefits of higher education, such as greater personal income, tax revenues, and public welfare savings (McMahon, 2009; Trostel, 2010).

Although appropriations revenue is directly associated with tuition levels (Bound et al., 2019), the fundamental role of appropriations in promoting timely degree completion likely stems from the provision of a high-quality learning environment rather than lower tuition (Deming & Walters, 2017). Direct appropriations should thus be conceived as a complimentary rather than substitutive policy lever for addressing college affordability. Need-based grant aid, for instance, is crucial for ensuring that students of modest means are able to afford college tuition, fees, and the associated cost of living. And yet, the positive effects of greater affordability may be offset by declining direct appropriations if the ability of campuses to promote student learning and timely degree completion is diminished. A reduction in the net price of college enrollment in the absence of high educational quality is tantamount to expanding college access without improving opportunities for student success (Taylor & Cantwell, 2019). Policymakers must thus consider both affordability and quality dimensions to higher education finance.

While institutional type was not a significant moderator in most cases, the direct effects of institutional type raise

some important questions for higher education finance. Particularly in the wake of the COVID-19 pandemic, a central policy challenge is to ensure that any reductions and stratification in state funding for higher education account for the differential ability of institutions to raise tuition revenue to compensate for lost appropriations as well as differences in the resource needs of institutions with students of varying academic backgrounds, social capital, and financial circumstances. Of concern in the current study are institutions that enroll and graduate a relatively large share of students from diverse racial and ethnic backgrounds. Specifically, bachelor's institutions, HBCUs, and HSIs had higher predicted graduation rates for diverse students than did other institutions, ranging from a 5 to 11 percentage point difference. Severe funding cuts for such institutions could have a negative impact on a state's progress toward meeting postsecondary attainment goals, particularly attainment equity for diverse populations.

Policymakers should also consider the role of federal funding for colleges and universities. While state governments must balance their budgets, the federal government does not. Constrained state budgets and higher education's ability to generate alternative revenue (mainly from tuition) have caused higher education to be treated as the balance wheel of state budgets (Delaney & Doyle, 2011). A federal-state partnership could be developed for higher education to provide direct federal funding for institutions and incentivize additional state funding. Similarly, there have been calls for a Title I-type program that would provide federal funding for colleges and universities that serve large shares of low-income students (Cummings, et al., 2021). Such federal approaches have the potential to provide significantly more public funding for higher education. However, careful attention would need to be paid to program design and any potential negative externalities.

Finally, as noted above, institutions appear to differ in the extent to which additional resources are ultimately converted into higher graduation rates, presumably owing to variation in institutional effectiveness and efficiency (e.g., Horn & Lee, 2016). The provision of robust public funding should thus be met with quality assurance efforts by institutional leaders to ensure that educational programs, policies, and services are in fact conducive to

timely degree completion. Past research has indicated that a comprehensive student support system, for example, can influence the likelihood of persistence and degree completion (Tinto, 2012), including advising, tutoring, and career counseling (Scrivener et al., 2015) as well as mental health services (Francis & Horn, 2017). Moreover, a set of institutional quality indicators by race and ethnicity could help identify access gaps and convey to policymakers any funding needs for improving educational equity (e.g., Horn & Tandberg, 2018).

CONCLUSION

Most states in the nation have articulated a commitment to improve college attainment rates over the next decade (Lumina Foundation, 2019). The realization of state attainment goals will partly depend upon whether cohort completion rates can be improved among all students and especially among students in Black and Latinx populations, which are projected to increase considerably through 2060 (Johnson, 2020). And yet, public colleges and universities are increasingly expected to do more with less, to improve student completion rates as direct appropriations decline and college costs rise. In contradistinction, this study demonstrates that state funding for public institutions should be bolstered, not weakened, to raise college completion rates. A reassessment of state appropriation levels is in particular need for under-resourced and minority-serving institutions such as HBCUs that have experienced diminished financial health under some performance-based funding models (Ortagus et al., 2020). Concomitantly, institutions should conduct a comprehensive quality audit to ensure that campus-based practices and policies add value to student learning outcomes and in fact promote timely completion among diverse student groups. The provision of adequate resources and their effective utilization will ultimately help ensure that public higher education minimizes the reproduction of racial inequalities and instead realizes its potential as an equalizer of economic and civic opportunity.

TABLE 1. Descriptive Statistics

	Time 1		Time 12	
	Mean	SD	Mean	SD
Total six-year grad rate	46.35	15.80	52.13	16.48
White six-year grad rate	47.39	16.77	54.13	17.01
Black six-year grad rate	37.70	19.08	42.01	19.06
Latinx six-year grad rate	40.53	19.75	47.75	18.36
Bachelor's Institution	0.10		0.15	
Research institution	0.40		0.37	
HSI	0.08		0.08	
HBCU	0.08		0.08	
FTE Undergraduate Enrollment (log)	8.74	0.84	8.92	0.85
FTE Graduate Enrollment Percent (log)	2.27	0.91	2.32	0.76
Admission Selectivity	28.39	16.92	34.22	17.41
Urbanization: Large city	.16		.16	
Urbanization: Other city	.32		.32	
Urbanization: Suburb	.19		.19	
Urbanization: Town rural	.33		.33	
Region: Far West	0.10		0.10	
Region: Great Lakes	0.13		0.13	
Region: Mid East	0.15		0.15	
Region: New England	0.07		0.07	
Region: Plains	0.11		0.11	
Region: Rocky Mountains	0.03		0.03	
Region: Southwest	0.11		0.11	
Percent Female in Cohort	55.92	8.06	55.39	7.89
Percent Female in Black Cohort	54.53	17.83	54.53	15.66
Percent Female in Latinx Cohort	55.24	17.23	55.42	12.47
Percent Female in White Cohort	54.58	10.78	53.77	10.23
Percent Underrepresented in Cohort (log)	2.71	0.94	3.06	0.79
Percent Pell Recipient	33.55	16.88	42.16	16.41
Percent Part-time (log)	2.76	0.69	2.62	0.69
Percent Over 25 (sqrt)	4.58	1.33	4.21	1.36
Immediate enrollment (inv log)	2.18	1.01	2.01	0.85
SAT 25th Percentile	919.08	104.10	939.81	107.94
Tuition and Fees (log)	1.56	0.31	2.12	0.28
Average Loan (1,000's)	4.35	1.33	6.96	1.28
Average Pell Grant (log)	8.25	0.23	8.45	0.08
Average State Grant (log)	7.81	0.51	8.02	0.63

TABLE 1. Descriptive Statistics (continued)

	Time 1		Time 12	
	Mean	SD	Mean	SD
Average Institutional Grant (log)	7.94	0.57	8.35	0.53
Tuition Percent of Educational Expenditures	49.40	16.43	53.76	16.40
Appropriations Percent of Educational Expenditures	91.77	26.50	50.57	18.79
Appropriations per FTE (log)	9.18	0.44	8.81	0.46

TABLE 2. Within-Between Mixed Model Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Institution-level intercept	-161.42***	21.20	-114.76***	26.08	-99.70***	26.06	-141.83***	23.53
Year 2	0.52**	0.19	-0.01	0.49	1.56**	0.61	0.57*	0.23
Year 3	0.87**	0.27	0.13	0.64	1.63*	0.79	1.23***	0.33
Year 4	0.91**	0.33	-0.07	0.75	2.32*	0.90	1.38**	0.40
Year 5	0.85*	0.37	-0.78	0.81	1.76	0.96	1.51**	0.45
Year 6	1.16**	0.41	-0.50	0.87	2.41*	1.03	1.90***	0.49
Year 7	1.69***	0.46	-0.43	0.97	3.64**	1.15	2.16***	0.56
Year 8	2.51***	0.52	1.43	1.08	4.57***	1.25	2.94***	0.63
Year 9	2.95***	0.60	1.99	1.22	5.05***	1.41	3.41***	0.72
Year 10	3.39***	0.64	2.73*	1.32	5.85***	1.50	3.64***	0.77
Year 11	3.86***	0.68	3.38*	1.39	5.87***	1.58	4.25***	0.82
Year 12	5.25***	0.71	4.72**	1.44	7.81***	1.63	5.47***	0.85
Bachelor's Institution	2.89**	0.92	5.38***	1.48	3.54	2.28	3.57***	1.01
Research institution	0.03	0.63	-0.62	0.77	0.22	0.78	-0.55	0.70
HSI	3.20***	0.87	4.59***	1.03	5.31***	0.86	2.40*	0.93
HBCU	4.26***	1.21	10.81***	1.48	4.45	2.97	-3.32	1.83
Urbanization: Suburb	3.14***	0.66	2.29**	0.79	1.65*	0.72	2.69***	0.72
Urbanization: Town or rural	4.58***	0.72	3.92***	0.88	2.31**	0.88	4.86***	0.80
Urbanization: Other city	2.41***	0.60	2.44**	0.71	1.51*	0.65	2.31**	0.68
Region: Far West	2.56	1.37	0.86	2.17	2.39	1.55	2.32	1.54
Region: Great Lakes	-0.83	1.37	-9.97***	2.02	-3.16	1.60	2.11	1.57
Region: Mid East	5.25***	1.39	1.99	2.02	0.32	1.65	6.87***	1.60
Region: New England	2.80	1.56	3.80	2.54	-0.14	1.90	2.74	1.74
Region: Plains	1.56	1.33	-7.16**	2.10	-2.47	1.66	2.55	1.49
Region: Rocky Mountains	-1.18	1.74	-0.12	7.62	-2.40	2.16	-1.69	1.93
Region: Southwest	-0.84	1.52	-3.74	2.29	-2.68	1.68	-0.45	1.71

TABLE 2. Within-Between Mixed Model Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions (continued)

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Between-Effects								
FTE Undergraduate Enrollment (log)	3.81***	0.43	4.79***	0.59	4.00***	0.61	4.06***	0.47
FTE Graduate Enrollment Percent (log)	1.19**	0.42	1.73**	0.66	1.91**	0.66	1.28**	0.45
Admission Selectivity	0.03	0.02	0.06**	0.02	0.10***	0.02	0.06**	0.02
Percent Female in Cohort	0.12***	0.03	0.17***	0.03	0.29***	0.03	0.13***	0.03
Percent Underrepresented Students	-2.73***	0.56	-0.48	0.84	-0.14	0.82	-1.79**	0.60
Percent Pell Recipient	-0.01	0.03	-0.08	0.05	-0.11*	0.04	-0.04	0.04
Percent Part-time (log)	-1.41	0.78	-5.18***	1.15	-2.91**	1.09	-1.06	0.85
Percent Over 25 (sqrt)	-2.01***	0.43	0.00	0.60	-1.68**	0.61	-2.33***	0.49
Percent delayed enrollment (log)	-2.45***	0.38	-2.34***	0.47	-1.52**	0.49	-1.86***	0.44
SAT 25th Percentile	0.07***	0.00	0.07***	0.01	0.07***	0.01	0.06***	0.01
Tuition and Fees (log)	3.69*	1.70	8.07***	2.27	5.55*	2.16	3.21	1.86
Average Loan (1,000's)	-0.54*	0.27	-0.25	0.34	-0.17	0.34	-0.41	0.30
Average Pell Grant (log)	10.43***	2.47	4.18	3.09	2.75	3.08	7.19**	2.74
Average State Grant (log)	0.18	0.65	1.38	0.94	-0.08	0.82	-0.51	0.73
Average Institutional Grant (log)	0.47	0.63	-0.88	0.86	-0.55	0.85	2.16**	0.71
Tuition Percent of Expenditures	0.02	0.02	-0.02	0.03	0.00	0.03	0.03	0.03
Appropriations Percent of Expenditures	-0.03	0.02	-0.01	0.03	0.02	0.02	-0.01	0.02
Appropriations per FTE (log)	2.51	1.35	-0.14	1.74	0.86	1.71	2.51	1.47
Within-Effects								
FTE Undergraduate Enrollment (log)	-2.52***	0.61	-3.11*	1.36	-4.28**	1.54	-1.25	0.77
FTE Graduate Enrollment Percent (log)	-0.48	0.31	-1.30	0.80	0.99	0.96	-0.74*	0.37
Admission Selectivity	0.00	0.00	0.01	0.01	0.02	0.02	0.00	0.01
Percent Female in Cohort	0.14***	0.02	0.11***	0.02	0.11***	0.02	0.15***	0.02
Percent Underrepresented Students	-1.83***	0.29	-4.04***	0.92	-3.17**	1.12	-0.72*	0.35
Percent Pell Recipient	-0.03***	0.01	-0.08***	0.02	-0.01	0.03	-0.01	0.01

TABLE 2. Within-Between Mixed Model Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions (continued)

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Percent Part-time (log)	0.63	0.41	-0.28	1.14	0.62	1.35	-0.14	0.49
Percent Over 25 (sqrt)	-1.07***	0.29	-2.56***	0.72	-2.48**	0.85	-0.61	0.36
Percent delayed enrollment (log)	-0.24**	0.08	-0.49*	0.19	-0.39	0.23	-0.27**	0.09
SAT 25th Percentile	0.01***	0.00	0.02***	0.00	0.02**	0.01	0.01***	0.00
Tuition and Fees (log)	1.73*	0.80	2.54	1.73	3.16	1.94	1.02	0.98
Average Loan (1,000's)	-0.12**	0.04	-0.15	0.11	-0.01	0.14	-0.07	0.06
Average Pell Grant (log)	0.30	0.35	-1.83*	0.88	0.35	1.15	0.53	0.44
Average State Grant (log)	0.12	0.18	0.27	0.43	-0.60	0.54	-0.09	0.23
Average Institutional Grant (log)	0.71***	0.18	0.38	0.44	0.33	0.53	0.83***	0.23
Tuition Percent of Expenditures	0.03	0.02	0.01	0.04	0.07	0.04	0.03	0.02
Appropriations Percent of Expenditures	-0.04**	0.01	-0.06*	0.03	-0.05	0.03	-0.06***	0.02
Appropriations per FTE (log)	2.14*	1.02	4.33*	1.97	4.12 ^a	2.12	2.99*	1.21
Covariance								
State-level intercept	4.11***	1.23	10.06***	2.92	4.70**	1.74	5.50**	1.67
AIC Difference	7892.44		5152.75		3554.69		7039.71	
OLS adjusted r-square	.91		.82		.85		.89	
n	4055		2938		2189		3787	

Note. The AIC difference compares the full model with a reduced model containing intercepts and time variables.

^a $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

TABLE 3. Within-Between Mixed Model with Random Slope Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Institution-level intercept	-161.15***	23.30	-134.52***	32.87	-122.89***	33.22	-145.49***	27.10
Year 2	0.53**	0.19	0.12	0.47	1.41*	0.60	0.52*	0.23
Year 3	0.87**	0.26	0.35	0.56	1.49*	0.69	1.15***	0.29
Year 4	0.87**	0.30	0.29	0.62	2.22**	0.76	1.29***	0.34
Year 5	0.75*	0.33	-0.39	0.66	1.61*	0.80	1.35***	0.36
Year 6	1.00**	0.35	-0.09	0.70	2.33**	0.85	1.70***	0.39
Year 7	1.44***	0.40	-0.03	0.79	3.52***	0.95	1.87***	0.44
Year 8	2.18***	0.45	1.91*	0.87	4.57***	1.03	2.56***	0.49
Year 9	2.61***	0.51	2.44*	1.00	5.39***	1.16	3.05***	0.56
Year 10	3.02***	0.55	3.06**	1.07	6.14***	1.23	3.24***	0.60
Year 11	3.44***	0.58	3.67**	1.13	6.04***	1.30	3.82***	0.63
Year 12	4.84***	0.61	4.96***	1.17	8.01***	1.34	5.08***	0.66
Bachelor's Institution	3.13**	1.02	6.03**	1.87	3.18	3.08	3.76**	1.18
Research institution	0.04	0.70	-0.94	0.89	-1.99*	0.93	-1.14	0.72
HSI	3.23**	0.96	4.67**	1.35	6.08***	1.21	2.48*	1.09
HBCU	4.15**	1.32	10.45***	1.88	6.05	3.60	-3.06	2.01
Urbanization: Suburb	3.15***	0.73	2.44*	1.04	1.92	1.00	2.74**	0.85
Urbanization: Town or rural	4.52***	0.80	3.89**	1.16	2.73*	1.18	4.81***	0.95
Urbanization: Other city	2.43***	0.67	2.53**	0.93	1.44	0.90	2.39**	0.80
Region: Far West	2.75	1.38	0.90	2.13	0.94	1.19	2.65	1.52
Region: Great Lakes	-0.86	1.37	-9.53***	1.95	-5.96***	1.29	1.81	1.54
Region: Mid East	5.19**	1.39	1.99	1.94	-1.28	1.29	6.58***	1.56
Region: New England	2.86	1.59	4.36	2.57	-2.92	1.74	2.54	1.77
Region: Plains	1.52	1.35	-6.42**	2.09	-3.77*	1.48	2.47	1.49
Region: Rocky Mountains	-1.19	1.79	1.03	7.60	-3.32	2.17	-1.56	1.98
Region: Southwest	-0.79	1.52	-3.48	2.21	-2.67*	1.20	-0.32	1.67
Between-Effects								
FTE Undergraduate Enrollment (log)	3.89***	0.48	4.54***	0.75	5.03***	0.80	4.32***	0.53
FTE Graduate Enrollment Percent (log)	1.17*	0.47	1.87*	0.84	1.19	0.87	1.25*	0.53
Admission Selectivity	0.04	0.02	0.07*	0.03	0.08*	0.03	0.06*	0.02
Percent Female in Cohort	0.12***	0.03	0.19***	0.04	0.30***	0.05	0.14***	0.03
Percent Underrepresented Students	-2.72***	0.60	0.04	1.05	0.02	0.98	-1.69*	0.68
Percent Pell Recipient	-0.01	0.04	-0.08	0.06	-0.10	0.06	-0.04	0.04

TABLE 3. Within-Between Mixed Model with Random Slope Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions (continued)

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Percent Part-time (log)	-1.54	0.86	-5.46***	1.45	-3.91**	1.32	-1.41	0.98
Percent Over 25 (sqrt)	-2.03***	0.47	0.04	0.76	-0.66	0.76	-2.18***	0.56
Percent delayed enrollment (log)	-2.49***	0.42	-2.67***	0.61	-1.79**	0.62	-1.93***	0.50
SAT 25th Percentile	0.07***	0.01	0.07***	0.01	0.07***	0.01	0.06***	0.01
Tuition and Fees (log)	3.58	1.84	6.06*	2.79	6.81**	2.53	3.65	2.10
Average Loan (1,000's)	-0.55	0.30	-0.33	0.43	-0.21	0.42	-0.39	0.34
Average Pell Grant (log)	10.14***	2.71	5.41	3.98	0.62	3.99	6.88*	3.19
Average State Grant (log)	0.32	0.69	1.65	1.07	0.20	0.83	-0.38	0.78
Average Institutional Grant (log)	0.32	0.68	-1.27	1.07	-1.16	0.98	2.18**	0.81
Tuition Percent of Expenditures	0.02	0.03	0.00	0.04	0.05	0.04	0.03	0.03
Appropriations Percent of Expenditures	-0.03	0.02	-0.01	0.03	-0.01	0.03	-0.01	0.02
Appropriations per FTE (log)	2.78	1.47	1.04	2.16	4.22*	2.06	2.81	1.66
Within-Effects								
FTE Undergraduate Enrollment (log)	-1.89**	0.60	-3.35**	1.24	-3.93**	1.44	0.17	0.72
FTE Graduate Enrollment Percent (log)	-0.64*	0.29	-1.63*	0.68	0.29	0.81	-0.83*	0.32
Admission Selectivity	0.00	0.00	0.02*	0.01	0.03*	0.01	0.01	0.01
Percent Female in Cohort	0.15***	0.02	0.12***	0.02	0.12***	0.02	0.17***	0.02
Percent Underrepresented Students	-2.09***	0.29	-3.81***	0.82	-3.28**	1.00	-1.31***	0.34
Percent Pell Recipient	-0.03***	0.01	-0.07***	0.02	-0.03	0.03	-0.01	0.01
Percent Part-time (log)	0.23	0.39	-0.60	0.97	-0.55	1.13	-0.63	0.44
Percent Over 25 (sqrt)	-1.42***	0.27	-2.57***	0.58	-2.17**	0.71	-1.16***	0.31
Percent delayed enrollment (log)	-0.23**	0.08	-0.55**	0.18	-0.34	0.21	-0.23*	0.09
SAT 25th Percentile	0.01***	0.00	0.02***	0.00	0.02***	0.01	0.02***	0.00
Tuition and Fees (log)	1.73*	0.74	2.07	1.42	2.70	1.58	1.10	0.83
Average Loan (1,000's)	-0.13**	0.05	-0.19	0.10	-0.03	0.13	-0.07	0.06
Average Pell Grant (log)	0.19	0.35	-1.86*	0.81	-0.23	1.04	0.44	0.43
Average State Grant (log)	0.12	0.18	0.20	0.38	-0.58	0.46	-0.03	0.21

TABLE 3. Within-Between Mixed Model with Random Slope Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions (continued)

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Average Institutional Grant (log)	0.68***	0.18	0.53	0.39	0.30	0.47	0.59**	0.22
Tuition Percent of Expenditures	0.02	0.02	-0.03	0.03	0.04	0.03	0.01	0.02
Appropriations Percent of Expenditures	-0.04***	0.01	-0.04	0.02	-0.04	0.02	-0.06***	0.01
Appropriations per FTE (log)	1.78 ^a	0.93	1.95	1.64	2.98 ^a	1.74	2.56*	1.00
Covariance								
State-level intercept	3.68**	1.21	7.10**	2.58	-	-	4.32**	1.59
Institution-level intercept	10.66***	1.07	18.58***	1.95	16.12***	1.84	14.66***	1.31
Appropriations per FTE (log)	23.85**	8.33	59.41***	17.36	28.66*	11.95	38.94***	9.04
AIC Difference	73.89		338.12		208.60		573.75	
OLS adjusted r-square	.91		.82		.85		.89	
n	4055		2938		2189		3787	

Note. The AIC difference compares the full model with a reduced model containing all variables except the random institution-level intercept and slope.

^a $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

TABLE 4. Standard Mixed Model Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Institution-level intercept	-55.80***	9.44	-69.37***	13.35	-86.36***	14.40	-84.70***	10.23
Year 2	0.05	0.20	-0.83	0.48	1.12	0.61	0.08	0.23
Year 3	-0.19	0.27	-1.53*	0.60	0.44	0.74	0.07	0.32
Year 4	-0.70*	0.33	-2.32**	0.68	0.64	0.80	-0.37	0.39
Year 5	-1.07**	0.36	-3.36***	0.71	-0.32	0.82	-0.59	0.42
Year 6	-0.94*	0.40	-3.38***	0.75	0.04	0.85	-0.25	0.46
Year 7	-0.61	0.45	-3.59***	0.81	1.21	0.92	-0.07	0.52
Year 8	0.13	0.51	-2.02*	0.88	1.93*	0.97	0.72	0.58
Year 9	0.55	0.58	-2.04*	0.99	2.11*	1.07	1.31*	0.65
Year 10	0.99	0.62	-1.79	1.05	2.69*	1.12	1.59*	0.70

TABLE 4. Standard Mixed Model Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions (continued)

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Year 11	1.57*	0.66	-1.18	1.10	2.60*	1.17	2.37**	0.74
Year 12	2.96**	0.69	0.14	1.14	4.42***	1.20	3.57***	0.77
Bachelor's Institution	-0.51	0.99	3.79**	1.42	1.74	2.25	0.85	1.00
Research institution	3.67***	0.72	-0.20	0.74	-0.56	0.74	1.80*	0.72
HSI	-0.59	1.05	3.77***	1.01	4.36	0.84	-0.63	1.00
HBCU	-4.71***	1.08	8.74***	1.28	-1.34	2.88	-12.08***	1.81
Urbanization: Suburb	3.38***	0.83	2.24**	0.79	2.32**	0.71	3.01***	0.80
Urbanization: Town or rural	2.59**	0.88	2.12*	0.88	1.27	0.87	3.41***	0.87
Urbanization: Other city	2.30	0.77	1.69*	0.72	1.22	0.65	2.10**	0.76
Region: Far West	0.46	2.03	0.42	2.58	1.95	1.75	0.22	1.92
Region: Great Lakes	-1.88	2.02	-10.54***	2.34	-4.45*	1.74	0.96	1.92
Region: Mid East	3.82	2.07	1.52	2.34	-0.36	1.81	5.97**	1.96
Region: New England	-0.53	2.06	0.35	2.84	-2.50	1.97	0.57	1.94
Region: Plains	-0.90	1.86	-10.71***	2.41	-4.90**	1.78	0.70	1.75
Region: Rocky Mountains	-5.04*	2.50	-7.56	8.10	-3.77	2.29	-4.54	2.33
Region: Southwest	-0.86	2.36	-3.74	2.72	-2.66	1.91	-0.24	2.21
FTE Undergraduate Enrollment (log)	2.06***	0.40	3.84***	0.54	3.49***	0.56	3.53***	0.42
FTE Graduate Enrollment Percent (log)	0.13	0.28	0.92	0.52	1.99***	0.55	0.14	0.31
Admission Selectivity	0.00	0.00	0.03**	0.01	0.05***	0.01	0.01	0.01
Percent Female in Cohort	0.13***	0.02	0.14***	0.02	0.17***	0.02	0.15***	0.02
Percent Underrepresented Students	-2.41***	0.28	-2.25***	0.62	-0.82	0.70	-1.35***	0.32
Percent Pell Recipient	-0.04***	0.01	-0.09***	0.02	-0.06*	0.03	-0.03**	0.01
Percent Part-time (log)	-1.13**	0.37	-2.92***	0.78	-2.49**	0.82	-1.80***	0.43
Percent Over 25 (sqrt)	-3.19***	0.23	-2.03***	0.42	-2.84***	0.47	-2.98***	0.27
Percent delayed enrollment (log)	-0.32***	0.08	-0.68***	0.18	-0.58**	0.21	-0.36***	0.10
SAT 25th Percentile	0.02***	0.00	0.05***	0.00	0.05***	0.00	0.03***	0.00
Tuition and Fees (log)	3.47***	0.78	5.38***	1.39	5.03**	1.45	3.04**	0.91
Average Loan (1,000's)	-0.12**	0.05	-0.18	0.10	-0.10	0.13	-0.08	0.06
Average Pell Grant (log)	0.17	0.36	-1.64	0.86	0.80	1.12	0.35	0.45
Average State Grant (log)	0.24	0.19	0.53	0.41	-0.49	0.47	0.01	0.23

TABLE 4. Standard Mixed Model Predicting Six-Year Graduation Rates by Race/Ethnicity at Public Four-Year Institutions (continued)

	All		Black		Latinx		White	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
Average Institutional Grant (log)	0.87***	0.18	0.54	0.40	0.36	0.45	1.22***	0.22
Tuition Percent of Expenditures	0.07***	0.02	-0.06	0.02	-0.02	0.02	0.08***	0.02
Appropriations Percent of Expenditures	-0.06***	0.01	0.03**	0.02	0.04	0.03	-0.06***	0.01
Appropriations per FTE (log)	6.98***	0.86	5.19***	1.22	4.64***	1.23	7.77***	0.95
Covariance Estimate								
State-level intercept	11.71***	3.16	15.89***	4.20	7.02**	2.31	10.20***	2.85
AIC Difference	7371.94		5053.51		3403.21		6667.26	
OLS adjusted r-square	.91		.82		.85		.89	
n	4055		2938		2189		3787	

Note. The AIC difference compares the full model with a reduced model containing intercepts and time variables.

* $p < .05$, ** $p < .01$, *** $p < .001$

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ADDENDUM

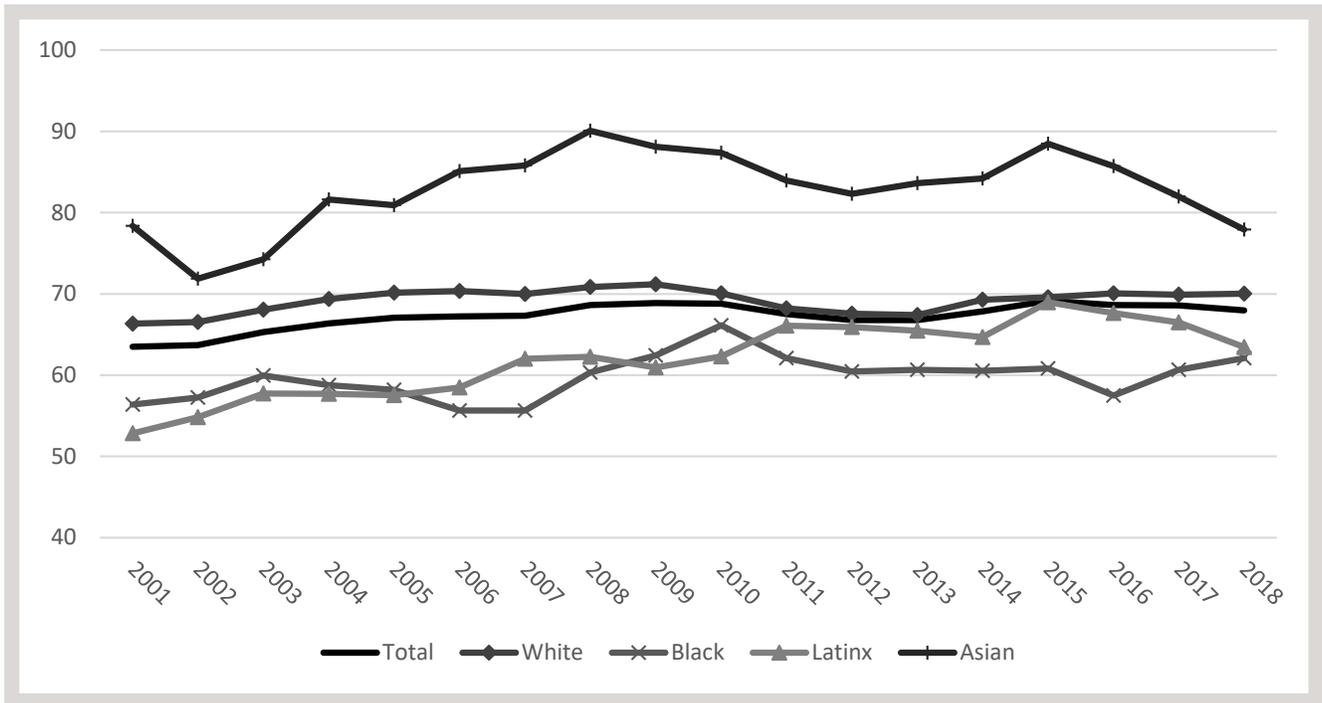
This Addendum provides an overview of national trends in postsecondary enrollment and completion, state appropriations, and factors that have been found to influence the level of state appropriations.

National Trends in Postsecondary Enrollment

Disparities are present at every step of the college pathway. Students from different racial and ethnic backgrounds enroll in college at different rates. Figure 1 indicates that Asian students have the highest enrollment rate directly

out of high school, while Black and Latinx students have the lowest rates. White students have a direct enrollment rate slightly higher than the national rate. The data indicate that direct enrollment rates have increased the most for Latinx students since 2001. Blacks and Whites have seen smaller increases over the time period, while the rate for Asians remains the same after increases and decreases.

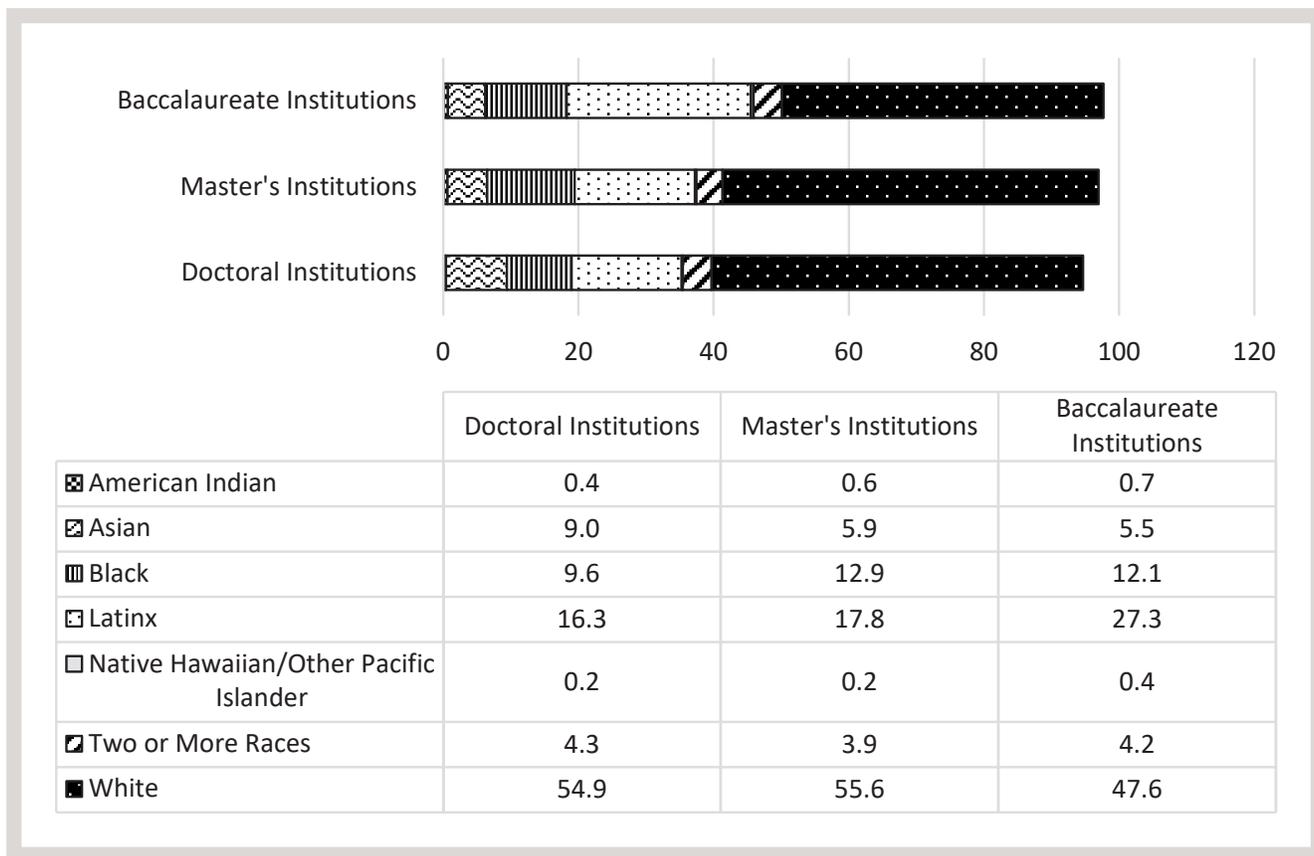
FIGURE 1. Percentage of Recent High School Completers Enrolled in College, by Race/Ethnicity (3-Year Moving Average)



Source. NCES.

Figure 2 shows differences in racial composition across public four-year institutions, wherein underrepresented students comprise a larger share of student enrollment at master’s universities than at research universities. In 2018, for instance, Black and Latinx students comprised 13% and 18% of total enrolment at master’s universities, compared to 10% and 16% at research universities (NCES, 2019). In contrast, the difference was smaller for White students, who represented 56% of students at master’s universities and 55% at research universities.

FIGURE 2. Enrollment Distribution by Race/Ethnicity at U.S. Public Four-Year Institutions, Fall 2018 (In Percentage Points)



Source. Authors’ analysis of IPEDS enrollment data.

Completion Gaps

Nationally, the completion gap between Whites and Blacks increased across all types of public four-year institutions from 2007 to 2018 (Table 1). Except for baccalaureate institutions, the completion gap between White and Latinx students decreased between 2007 and 2018. While the completion gap between Whites and underrepresented minorities increased at baccalaureate institutions, the gap slightly decreased at master's and doctoral institutions.

TABLE 1. National Race/Ethnicity Gaps in Six-Year Graduation Rates at Public Four-Year Institutions (In Percentage Points)

	White vs. Black	White vs. Latinx
All Institutions		
2007	18	12
2018	22	9
Baccalaureate Institutions		
2007	15	9
2018	21	10
Master's Institutions		
2007	16	14
2018	20	8
Doctoral Institutions		
2007	17	10
2018	21	9

Source. Authors' analysis of IPEDS graduation data.

Trends in State Appropriations

Nationally, Table 2 shows that total educational revenue, state and local appropriations, and tuition revenue increased from 2003 to 2018 at all types of public four-year institutions across the U.S.

TABLE 2. Postsecondary Educational Revenue per FTE Student by Institution Type at U.S. Public Four-Year Institutions

Year	Total Revenue per FTE	Total Appropriations per FTE	Total Tuition per FTE
Baccalaureate Institutions			
2003	\$9,818	\$6,424	\$3,394
2018	\$11,174	\$6,400	\$4,774
Master's Institutions			
2003	\$11,651	\$7,262	\$4,389
2018	\$12,909	\$6,455	\$6,454
Doctoral Institutions			
2003	\$16,182	\$9,977	\$6,205
2018	\$18,865	\$7,713	\$11,152

Source. Authors' analysis of IPEDS finance data.

Factors Influencing Appropriations Level

Several factors have been examined that attempt to explain levels of state support for higher education. Political conditions are identified as one factor. Several studies show that the presence of a Democratic governor or a Democratic-controlled legislature is positively related to state support of higher education (Ness & Tandberg, 2013). However, other studies show that due to increased competition among party priorities, this relationship between state spending on higher education and Democratic Party control is negative (Dar & Lee, 2014). Aside from party politics, political culture is another aspect of a state's political conditions that explain spending. States with a traditionalistic political culture spend more on higher education than do states with an individualistic political culture (Heck et al., 2014). Additionally, states with more professional legislatures have higher levels of higher education spending (McLendon et al., 2009; Tandberg, 2010).

A state's economic conditions constitute another factor that explains state support levels. Higher wealth and low unemployment are related to more spending on higher education (Heck et al., 2014; Toutkoushian & Hollis, 1998). Additionally, increased unemployment weakens the positive relationship between Democratic Party control and state higher education funding levels (Dar & Lee, 2014). Also, states with higher income inequality allocate more of their resources to higher education (Tandberg, 2009).

The organization and composition of higher education institutions affect funding levels as well. For instance, a state's governance structure of higher education impacts higher education funding levels. Consolidated governing boards negatively impact funding for higher education, as these types of boards act as a buffer by isolating decision makers from those who would have an interest in increasing state support for higher education (Tandberg, 2013). Additionally, the presence and size of private institutions within a state affects funding for public institutions. Doyle (2012) finds that as the number of students that enroll at private institutions in a state increases, tuition at public institutions decreases and state financial aid spending increases.

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Vision MHEC members collaborate to address the region’s most pressing challenges in higher education and transform educational opportunities so that people and communities thrive.

Mission MHEC brings together midwestern states to develop and support best practices, collaborative efforts, and cost-sharing opportunities. Through these efforts it works to ensure strong, equitable postsecondary educational opportunities and outcomes for all.

Who MHEC Serves MHEC is comprised of member states from the midwestern United States. MHEC works with and for a variety of stakeholders within and across member states, including higher education system leaders, state policymakers, legislators, and institutional leaders, while always maintaining a focus on students and their success.

How MHEC Works MHEC’s strategic approach highlights member states’ strong desire for collaboration, effectiveness, and efficiency. MHEC believes that collaborative actions informed by research and best practices are the catalyst for improving quality, accessibility, relevance, and affordability of postsecondary educational opportunities. MHEC does this primarily through the following approaches: convenings, programs, research, and cost-savings contracts. Increasingly, MHEC looks to leverage these approaches in conjunction with each other to serve its strategic priorities.

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